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1988
PLAN OF WORK

for Cooperative Hydrology Investigations

Bureau of Land Management & U.S. Geological Survey -- Water Resources Division

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Preface

The Bureau of Land Management (BLM) each year requires data collection and analysis and technical consulting services of its sister agency, the U.S. Geological Survey (GS). For Fiscal Year 1988 services are requested of the GS's Water Resources Division.

The Plan of Work includes both Federal Coal Management Program (CMP) and non-CMP work items. Non-CMP work items are identified by a separate BLM appropriation code included in each work item description. Agency technical contacts for the 1988 BLM/GS contract are as follows:

Bureau of Land Management

Service Center
Eric B. Janes, Contracting Officer's Representative, and Hydrologist (FTS 776-0170).

U.S. Geological Survey

Water Resources Division
Donald A. Goolsby, Regional Energy Coordinator, Central Region (FTS 776-5937)

Donald L. Coffin, Regional Program Officer, Central Region (FTS 776-5929)

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SUMMARY OF BLM FUNDS FOR HYDROLOGIC INVESTIGATIONS
USGS WATER RESOURCES DIVISION
1988

STATE	4121	4134	4341	O & C 6333	TOTAL
Colorado	$148,000		$ 56,330		$204,330
Idaho			10,550		10,550
Montana	241,500				241,500
Oregon				$18,480	18,480
Utah	151,000		20,120		171,120
Washington		15,000		6,000	21,000
Wyoming	85,000				85,000
TOTALS	$625,500		$ 87,300	39,480	$751,980

PLAN OF WORK
for
HYDROLOGIC INVESTIGATIONS
BUREAU OF LAND MANAGEMENT AND
USGS WATER RESOURCES DIVISION
Fiscal Year 1988

AUTHORITY

The General Agreement between the Bureau of Land Management (BLM) and the Geological Survey (GS), dated June 14, 1985, is considered the basis for this Plan of Work.

PURPOSE

The purpose of this Plan of Work is to specify the nature and amount of assistance to be provided by GS to BLM during FY 88.

SCOPE

This Plan of Work includes hydrologic services to be provided by GS to BLM in Fiscal Year 1988 in the States of Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming.

GS will provide the services, including personnel, equipment, supplies, and facilities, to conduct water resources investigations in areas designated by BLM. Services will include installation, operation, and maintenance of surface-water gages, ground-water wells, and climate stations, water-quality data collection and analysis.

PROCEDURE

Fiscal Year 1988 is the fourteenth year of this cooperative effort. Some work that began in earlier fiscal years will be continued in Fiscal Year 1988, although some projects may be dropped. A few studies will begin in Fiscal Year 1988; some will carry over into Fiscal Year 1989. Proposals will be discussed in joint meetings among GS WRD District Offices, BLM State Offices, and the Service Center. The Plan of Work will be developed by the Service Center after negotiations among BLM field offices to determine needs and GS field offices to determine capabilities, recommended hydrologic procedures, and to coordinate with other studies conducted by GS in other programs. The development of budgets takes into account the program needs of both agencies and funds available to meet those needs. When mutual interests are strong, funds from both agencies are applied. Funds tabulated in the work order, however, represent only those from BLM.

Field investigative procedures will be standard GS techniques for water resources investigation.

REPORTS

Reporting will generally be standard GS report procedures with some deviations that are detailed in the Plan of Work.

Annual project progress reports will be prepared by each Water Resources Division District and routed through the Central Region to the Contracting Officer's Representative (BLM). Due date for these reports will be September 30, 1988. GS will provide the appropriate BLM State Office with a copy of each progress report.

Prior to publishing any work involving BLM funds, GS will forward copies of the draft final project report to the appropriate BLM State Office contact for review and approval. GS will forward two copies of the published reports to the Contracting Officer's Representative (BLM) and as many copies to the appropriate BLM State Office as agreed upon mutually between GS and BLM.

FUNDING

BLM will provide $751,980 to GS to cover all authorized work listed in this Plan of Work in FY 88. Billing will be through OPAC Form, which will be current as of the beginning of the quarter during which the interagency agreement is signed. Subsequent bills will be issued at 3-month intervals except during the last quarter when bills will be submitted at 1- to 2-month intervals. As a part of the interagency agreement and/or modifications thereto, BLM will provide a table showing funding sources for BLM/USGS cooperative hydrology investigations. GS will consider this account a reimbursable account with 1-year funds.

COLORADO

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

	Project Name	4121	4341
I	Hydrology of Coal Spoils, NW Colorado	136,000	
II	Operation of BLM Stations, San Luis		24,220
III	Hydrologic Investigations, Badger Creek		20,110
IV	Sand Wash Sediment		12,000
V	Foidel Creek Monitoring	12,000	
	TOTAL:	$ 148,000	$56,330

Total for State of Colorado: $204,330

COLORADO

Neil Morck, BLM, State Director (FTS 776-1721)
Betsy Daniel, BLM, Hydrologic Investigations Coordinator (FTS 776-1778)
Steve Vandas, BLM, State Hydrologist (FTS 776-1762)
Rhio Jackson, BLM, Project Core Team Member, Service Center (FTS 776-0141)
C.A. (Jerry) Pascale, WRD, District Chief (FTS 776-1762)

I. Hydrology of Coal Spoils in NW Colorado (RDTS 3340.187)

Robert S. Williams, Jr., WRD Project Chief, FTS: 776-9404

A. Location: The study area is located in northwestern Colorado between Steamboat Springs and Craig and extends from an east-west line from the Yampa River at the north to approximately 20 miles south of the Yampa River.

B. Introduction: The project, also known as "Hydrology and Geochemistry of Reclaimed Coal Spoils in Northwestern Colorado," is jointly funded by BLM, the U.S. Office of Surface Mining, Reclamation and Enforcement (OSMRE), USGS-WRD, and the Mined Land Reclamation Division of the Colorado Department of Natural Resources (CMLRD). Representatives of each of the participating agencies serve on an advisory team.

The original project proposal was developed by an informal committee of BLM, OSMRE, USGS-WRD, and CMLRD staff members during 1985 and 1986. The Spoil Aquifer Hydrology project, first funded in 1985 by BLM, supported the preliminary field evaluations necessary to finalize the proposal. Continued funding has been provided by BLM and OSMRE in Fiscal Years 1986, 1987, and 1988. In concept, the two agencies have agreed to share funding of the project on an equal basis. USGS-WRD contributed cooperative funding to the project in 1987, which CMLRD matched with evaluated services.

Accomplishments of the project are described in the FY 87 progress report. Installation of project field equipment commenced in early summer of 1987. Equipment installation was completed at the end of 1987. The hydrologic and geochemical conditions encountered differ significantly from the originally hypothesized conditions. As a result of interpretation of preliminary data, the project work plan has been amended. The proposed project work plan changes entail significantly modified data collection, sample analysis, and interpretation levels of effort and scheduling. Five optional work plan scenarios were presented within this amendment proposal. Following selection of the preferred scenario (957K), it was necessary to amend the budget projections, commensurately.

C. Objectives: This project will describe the processes controlling the hydrology of reclaimed coal spoils:

1. Determine the sources of recharge to and discharge from reclaimed coal spoils.

2. Determine the rate of water movement through reclaimed coal spoils.

3. Determine the geochemistry of a reclaimed coal spoil and the magnitude of change in concentrations of dissolved constituents in coal-spoil discharge.

D. Preliminary Findings: Because of unexpected hydrologic complexity, additional monitoring wells were required at each of the study sites. This significantly increased drilling, sampling, water-quality analyses, and interpretation project costs.

The variations in hydraulic head make it unclear if water is flowing into the reclaimed coal spoil from surface recharge, deep recharge, or both. Because the system appears to be very dynamic, seasonal flow changes could be significant. Consequently, increased monitoring and sampling frequencies are necessary to understand the system and to have confidence in transferability of project results.

Recharge to the reclaimed spoil was originally assumed to be from precipitation. However, preliminary findings indicate recharge may be from underlying aquifers. The chemical quality of the recharge water will differ depending on the source or recharge. To understand and model the flow and quality of the aquifer, the source of recharge water must be identified. For example, water flowing from the spoil springs may be from surface recharge in the spring and summer of the year and exhibit one type of chemistry; whereas during other seasons of the year, underburden recharge may be a major source of water and therefore spoil spring chemistry may change. Water that flows from the reclaimed coal spoil into the undisturbed bedrock aquifers may also change and may impact offsite ground-water chemistry.

High conductance values found in the undisturbed aquifers downgradient from the reclaimed coal spoil raised questions regarding possible offsite impacts. The undisturbed aquifer system water chemistry may either change dramatically or buffer the chemistry of the water coming from the reclaimed coal spoil. To address this important question, additional downgradient wells were drilled. These wells will allow comparison of upgradient and downgradient hydraulic head differences, hydraulic connections between aquifers, and water chemistry.

E. Project Approach Modifications: Project work was originally planned to take place on three mines. One site was to be studied at each mine. Access problems at two of the mines prevented implementation of the original plan. Consequently, the Seneca II Coal Mine operated by the Peabody Coal Company was selected for the entire study. Implementing and completing the study at the Seneca II Coal Mine actually enhances the project's usefulness, applicability, and transferability.

Three sites were selected at the Seneca II Coal Mine after access problems at the other mines occurred. Two of the sites were reclaimed coal spoil areas, and one site was undisturbed (except for topsoil removal). The reclaimed coal spoil sites are on western and southern aspects. The undisturbed site faces east. The undisturbed site presents an unique opportunity to study a site in transition from undisturbed to disturbed conditions. This site will be mined during the project life. Additional wells will be drilled in reclaimed coal spoil after the area is mined and reclaimed. This site will offer valuable information on the changes that occur in an area as mining commences, progresses, and ends. The information will serve as baseline to evaluate other coal mine areas. An understanding of undisturbed conditions adds a key element to overall assessment of coal strip mines.

The reclaimed coal spoil sites will meet original project objectives to determine the quantity and quality of water flowing through reclaimed coal spoil and the duration of impact that mining had on the hydrologic system. These principal objectives can still be met because the sites are typical of the climatological and hydrogeological settings at coal mines in northwestern Colorado. The hydrological and geochemical processes acting at the Seneca II Mine should also be in effect at other mines in the area. Therefore, transferability of project findings should not be a problem in northwestern Colorado. As planned, confidence limits regarding transferability of findings to other areas will be determined at the end of the study. Other management determinations will be made by the study advisory group.

Initially three bedrock wells were to be installed at each site. However, ground-water conditions are far more complex than was hypothesized or reported previously. Consequently, a fourth well was drilled to more fully evaluate the undisturbed ground-water system downgradient from the reclaimed coal spoil. Additionally, a fourth site was selected downgradient from one of the reclaimed coal spoil sites. More specific preliminary project findings are discussed in the FY 87 progress report.

F. Reports:

Progress Reports

USGS-WRD, with assistance and input from other advisory team members, will give one or more annual oral presentations describing progress and significant results. The purpose of these presentations will be to provide preliminary information to interested groups as soon as possible.

Final Interpretative Report

USGS-WRD will prepare a Water-Resources Investigation Report or a Water Supply Paper upon completion of the study.

Regulatory-Management Reports

Some advisory team representatives intend to produce separate management-related reports based upon results from the USGS-WRD final interpretive report. These reports will discuss the regulatory program implications of the investigative conclusions of the study.

G. Expenditure Modifications: Expenditure requirements have increased in many work elements and decreased in a few. An itemized list of funding is addressed in the FY 87 progress report. Additional drilling was necessary to properly depict the undisturbed ground-water system near the reclaimed coal spoil and also downgradient from the reclaimed coal spoil. As explained in the project findings (FY-87 Progress Report), the frequency of sampling needs to be increased to characterize the source of water to the reclaimed coal spoil and to depict seasonal variations that may occur in the disturbed and undisturbed hydrologic system.

H. Distribution of Funds (YA-470-4121-07-2513):

BLM	$136,000
OSM	$179,500
USGS Coop	$ 30,000
Total	$345,500

II. Operation of BLM Stations in San Luis Valley

Russell K. Livingston, WRD Project Chief, (303) 544-7155

A. Location: Five study sites in San Luis Valley--one reservoir site (change in contents) and four reservoir sites (inflow). Recording rain gages are operated at five sites. Twenty supplemental nonrecording rain gages are also operated to provide spatial definition of precipitation.

B. Objectives: To determine effects of land-use changes on small drainage area runoff. Daily flow and rainfall will be tabulated for the four reservoir sites.

C. Report Products: Data are published annually in *Water Resources Data for Colorado*.

D. Distribution of Funds: (CO-050-4341-14-2512)

Salaries	$21,300
Travel and Vehicles	2,920
TOTAL	$24,220

III. Hydrologic Investigation of Badger Creek

Russell K. Livingston, WRD Project Chief, (303) 544-7155

A. Location: Badger Creek, tributary to Arkansas River

B. Objectives: To determine surface-water quantity and sediment-yield characteristics of Badger Creek watershed at two data collection sites. Crest stage gages will also be operated at four sites in the Badger Creek watershed to determine source areas of flood discharge.

C. Report Products: Data are published annually in Water Resources Data for Colorado.

D. Distribution of Funds (CO-930-4341-06-2512):

Salaries	$13,800
Travel and Vehicles	2,600
Laboratory	3,710
TOTAL	20,110

IV. Sand Wash Sediment

Robert L. Tobin, Meeker Office, (303) 878-5086

A. Location: Sand Wash Basin is in northwestern Colorado, approximately 50 miles west-northwest of Craig.

B. Objectives: To continue to collect flow, sediment, and water-quality data to define the hydrologic characteristics of Sand Wash Basin.

C. Approach: Operate a continuous flow-gaging station and periodically collect samples of suspended and bedload sediment, and water quality to define variations with stage. Yearly data collection would include:

1. Suspended sediment . . . 10-15 samples.
2. Suspended-sediment size analyses . . . 6 samples.
3. Bedload . . . 2-4 samples.
4. Water chemistry . . . 4 samples.

D. Reports: All data will be published in Water Resources Data for Colorado.

E. Distribution of Funds (CO-010-4341-14-2512):

Salaries	$ 8,000
Vehicles and travel	1,500
Laboratory	2,200
Supplies	300
TOTAL	$12,000

V. Foidel Creek Monitoring

A. Location: Foidel Creek, Colorado is located in the Yampa Coal Basin, northwestern Colorado.

B. Objectives: To provide a continuous record of hydrologic conditions on Foidel Creek that spans premining, mining, and postmining periods.

Approach: Continued operation of a snow course, minimonitor, and precipitation gage during this fiscal year by the USGS Water Resources Division.

C. Report Products: Precipitation, snow depth, daily temperature, and conductivity records.

D. Timeframes: Funding is provided for the data collection described above for Fiscal Year 1988. All equipment to accomplish this work is already in place.

E. Budget: Funding will be provided for operation of the snow course, minimonitor, and precipitation gage.

F. Distribution of Funds (CO-920-4121-06-2519): $12,000

IDAHO

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Project	4341	Total
I Operation and Maintenance of Gaging Stations	$10,550	$10,550

Total for the State of Idaho: $10,550

IDAHO

Delmar D. Vail, BLM State Director (FTS 554-1401)
Ervin Cowley, BLM Hydrologic Investigations Coordinator (FTS 554-1892)
Jerry L. Hughes, WRD District Chief (FTS 554-1750)

I. Operation and Maintenance of Two Gaging Stations

Robert W. Harper, WRD Project Chief (FTS 554-1750)

A. Location:

1. Lolo Creek, near Greer, ID
2. Sawmill Creek, near Clyde, ID

B. Data Collection: October 1, 1987 through September 30, 1988.

C. Reports: To be published in the USGS *Water Resources Data for Idaho*.

D. Distribution of Funds:

One station @ $5,860 (ID-060-4341-14-25-12)	5,860
One station @ $4,690 (ID-030-4341-14-25-12)	4,690
TOTAL	$10,550

MONTANA

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Project	4121
I. Hydrologic Characterization	
A. Streamflow and Quality	$58,500
B. Ground-Water Monitoring	37,000
II. Cumulative Effects in Hanging Woman Creek Basin	46,000
III. Hydrogeochemical Processes in Surface Coal-Mine Spoils, Southeastern Montana	100,000
TOTAL	$241,500

Total for State of Montana: $241,500

MONTANA

Marvin LeNoue, BLM Montana State Director (FTS 585-6461)
Peter Bierbach, BLM Hydrologic Investigations Coordinator (FTS 585-6655)
Joe A. Moreland, WRD, District Chief (FTS 585-5302)

I. Hydrologic Characterization of Eastern Montana Coal Areas (BLM-RDTS-7210.102/3340.502)

A. Network Maintenance of Streamflow

Ronald R. Shields, WRD Project Chief (FTS 585-5263)

1. Objectives: To collect streamflow data at key locations to supplement other programs. These data are essential in defining runoff and water quality from potential impact areas, determining streamflow characteristics, and providing a data base from which future changes can be analyzed.

2. Procedure: Standard U.S. Geological Survey methods of surface-water and water-quality data collection will be used to obtain data at the following stations:

Tongue River at Tongue River Dam-Q
Rosebud Creek at mouth near Rosebud-S,Q
Hanging Woman Creek near Birney-S,Q
Armell's Creek near Forsyth-S,Q
Otter Creek at Ashland-S,Q
Small drainage program-S
(Rosebud Creek near Kirby)
(Timber Creek near Van Norman)
(Clear Creek near Lindsay)

S = Streamflow   Q = Water quality

3. Report Products: Basic records from streamflow sites will be submitted to BLM annually or as mutually agreed upon. Records will be published by USGS in an annual report, Water Resources Data for Montana. These data will be used by USGS in preparing interpretive reports described in other parts of the work plan.

4. Relationship to Other USGS Studies: This program will supplement and will be correlated with other USGS streamflow data collection programs. Numerous other stations are operated in this area.

5. Distribution of Funds:

Salaries	$34,500
Lab	10,000
Travel	9,000
Supplies	2,000
Data Processing	3,000
TOTAL	$58,500

B. Ground-Water Monitoring

Robert Davis, WRD Project Chief (FTS 585-5263)

1. Location: Fort Union and Powder River Basin coal regions of eastern Montana.

2. Objectives: To provide a ground-water data base from which an assessment can be made of the resource, future responses to stresses can be predicted, and pollution and supply problems can be detected and defined. This activity provides for long-term collection of ground-water data from selected observation wells. Specifically, wells monitored in CMP study sites are incorporated in this program to extend periods of data collection. A 4-year rotational water-quality sampling program, including about 20 samples per year, will be reinitiated.

3. Procedures:

   a. Make water-level measurements and continue operation of water-level recorders.
   b. Compile and analyze data.
   c. Collect ground-water samples from about 20 wells.
   d. Analyze water samples.

4. Report Products: Data collected under this program will be incorporated in CMP Site Study reports and in regional evaluations. These data will be stored in automated data files for rapid retrieval.

5. Relationship to Other USGS Studies: Data collected under this activity will be used to help define premining conditions of potential lease sites, help calibrate ground-water models to predict the effects of mining, and help transfer data to surrounding areas from intensively studied sites.

6. Distribution of Funds:

Salaries for Data Collection	$19,500
Laboratory Services	3,000
Travel	10,500
Data Processing	4,000
TOTAL	$37,000

II. Cumulative Effects of Coal Mining on Water Quality in Hanging Woman Creek Basin, Southeastern Montana (BLM-RDTS-7210.142)

Michael R. Cannon, WRD Project Chief (FTS 585-5263)

A. Location: The study area is in the Powder River coal region and includes part of Rosebud County.

B. Objectives: To develop a dissolved-solids load budget and evaluate the potential effects of surface coal mining on dissolved solids in the stream and alluvial aquifer, both of which are used for irrigation of agricultural crops.

C. Procedures:

1. Supplement existing surface-water flow and quality data by related studies.
2. Inventory and sample existing wells in the basin.
3. Install observation wells where necessary. Obtain cuttings from the drilling.
4. Data evaluation:

   a. Develop and solve a mass-balance equation that defines all inflows and outflows of dissolved solids for the basin.

   b. Predict the quality and quantity of spoils water that would be generated by the postmining landscape. Perform batch-mixing experiments using cuttings. Compare results to paste-extract data from related study.

   c. Combine the additional load from the mined area with the budget equation for the undisturbed stream-aquifer system to determine the effects on dissolved-solids concentrations.

D. Report Products: Data and results will be published in the USGS Water-Resources Investigations series by September 30, 1988.

E. Relationship to Other Studies: Paste-extract data may be obtained by a proposed concurrent study by the Montana Bureau of Mines and Geology.

F. Distribution of Funds:

	FY 88
Salaries	$35,000
Travel	2,000
Computer and Miscellaneous	2,000
Report Processing	7,000
TOTAL	$46,000

III. Hydrogeochemical Processes in Surface Coal-Mine Spoils, Southeastern Montana

Michael R. Cannon, WRD Project Chief (FTS 585-5263)

A. Location: Powder River coal region in southeastern Montana.

B. Objectives: The objectives are to: (1) develop a Geographic Information System (GIS) data base from relevant and available data files for use in cumulative hydrologic impact analysis studies, and (2) expand the knowledge of hydrogeochemical processes that occur both onsite and offsite in ground water as a result of surface coal mining at two hydrologically different sites.

C. Procedures:

Objective 1: Determine availability and relevance of existing hydrologic and geographic data for selected areas of surface coal mining. Acquire necessary computer hardware and software for data processing. Enter data into GIS data base. Demonstrate system capabilities and transfer data base to state's Natural Resource Information System.

Objective 2: Install test wells at Big Sky and Decker mines. Collect solid-phase and aqueous-phase samples for extensive analysis. Evaluate data using geochemical models, such as WATEQF, BALANCE, and PHREEQE.

D. Report Products:

Objective 1: A USGS Open-File Report will be prepared by September 1990 describing the GIS, the types of data files it contains, and the sources of data.

Objective 2: A USGS Water-Resources Investigations Report will be prepared by September 1990 describing the results of the hydrogeochemical research.

E. Relationship to Other Studies: Additional work toward achieving both objectives is being funded by USGS and the Montana Department of State Lands, with support from the Office of Surface Mining, Reclamation and Enforcement.

F. Distribution of Funds:

	FY 88	
	Objective 1	Objective 2
Salaries	$55,800	$17,800
Travel	1,700	3,500
Equipment	3,500	1,700
Software	9,000	---
Laboratory Services	---	7,000
Report Processing	---	---
Subtotal	$70,000	$30,000

TOTAL - $100,000

OREGON

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Project	6333
I. Operation and Maintenance of Stream Gages	$18,480
Total	$18,480

Total for State of Oregon: $18,480

OREGON

Charles W. Luscher, BLM State Director (FTS 429-6251)
Bill Brookes, BLM Hydrologic Investigations Coordinator (FTS 429-2253)
M.D. Fretwell, WRD State Office Chief (FTS 429-2009)

I. Operation and Maintenance of Three Stream Gages

A. Location:
1. Tucca Creek near Blaine, Oregon (OR 080)
2. East Fork Lobster Creek near Alsea, Oregon (OR-080)
3. Star Gulch near Ruch, Oregon (OR-110)

B. Product Output:

1. Data from these gages will be entered into WATSTORE and published in the annual report Water Resources Data for Oregon.
2. BLM Districts will be provided primaries and a year-end station analysis for these gages.

C. Distribution of Funds (6333-14):

O & M of three gages @ $6,160	$18,480
TOTAL	$18,480

UTAH

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Unita-Southwestern Utah Coal Region

	Project	4341	4121
I.	Cooperative State Programs (UT-1, 3, and 4)	$20,120	
II.	Rock fractures and coal cleats and their effect on ground-water hydrology in the coal fields of central Utah		$126,000
III.	Hydrologic Evaluation of the Quitchupah, Pines, and L.C. Holding Coal-Lease Areas, Utah		25,000
	TOTALS	$20,120	151,000

Total for State of Utah: $171,120

UTAH

Kemp Conn, Acting BLM State Director (FTS 588-5311)
Boyd Christensen, BLM Hydrologic Investigations Coordinator (FTS 588-3120)
Harvey Lee Case III, WRD District Chief (FTS 588-5663)

I. Cooperative State Programs (UT-1, 3, and 4)

Larry Herbert, Project Chief (FTS 588-4192)

A. Objectives: To determine the sediment, salinity, and discharge of selected streams in San Juan and Garfield Counties.

B. Approach: Operate and maintain sediment, water quality, and gaging stations during FY 88.

C. Report Products: Information will be included in annual basic data report. BLM may request data directly if needed.

D. Distribution of Funds:

UT-1 Collection of streamflow records.

Indian Creek	5,190
Bull Creek	5,190
Montezuma Creek (Cost shared with SCS)	2,600
SUBTOTAL	$12,980

UT-3 and 4 Collection of chemical quality, and sediment records.

Bull Creek	4,760
Montezuma Creek (Cost shared with SCS)	2,380
SUBTOTAL	$ 7,140
TOTAL	$20,120

II. Rock Fractures and Coal Cleats and Their Effect on Ground-water Hydrology in the Coal Fields of Central Utah (UT-189)

Geoff Freethey, Project Chief (FTS 588-4184)

A. Location: Wasatch Plateau, Emery, and Book Cliffs coal fields in parts of Carbon, Emery, Sanpete, Sevier, and Utah Counties.

B. Objectives: To determine, quantitatively where possible, the effects of fractures (both natural and subsidence induced) and coal cleats on:

1. Hydraulic conductivity and anisotropy
2. Natural movement of ground water
3. Inflows of ground water to underground mines

C. Approach: The study is being carried out during the period October 1, 1987 to January 31, 1990 by collecting the following types of data and applying the following approaches:

1. Identify and map surface fractures using Landsat imagery and low altitude aerial photographs. Relate folds, faults, and lineaments to spatial distribution of fractures and to ground-water discharge points.

2. Measure orientation, frequency, continuity, and aperture of fractures at outcrops and in mines. Measure fracture density in selected core samples.

3. Measure ground-water flow from fractures inside mines and determine if the quantity is related to fracture orientation.

4. Collect and analyze water samples from fractures for geochemical and isotopic tracers to determine the length of time water has been in the ground.

5. Determine the degree to which fracturing changes hydraulic conductivity by using applicable mathematical models or other methods of analysis to selected aquifer-test results for the area.

6. Estimate principal axes of hydraulic conductivity using stereonet plots of fracture orientation and density.

D. Progress: Project is in initial stages of literature review and planning.

E. Reports: No reports are planned for FY 88.

F. Distribution of Funds:

Salaries and benefits	$94,400
Travel costs	18,600
Technical consultation	4,000
Chemical analysis	3,400
Supplies, equipment, base maps	5,600
TOTAL	$126,000

III. Hydrologic Evaluation of the Quitchupah, Pines, and L.C. Holding Coal-Lease Areas, Utah. (UT-176)

Gail E. Cordy, Project Chief, (FTS 588-4187)

A. Location: Coal leases in the Wasatch Plateau and Kolob coal fields in Sevier, Emery, and northwestern Kane Counties, Utah.

B. Objectives: To collect hydrologic and geologic data in and near the coal-lease areas that have been designated by BLM as priority areas in their coal-leasing program. These data will enable the following premining aspects of the local hydrology to be characterized:

1. Average streamflow, variability in flow, quality, and fluvial-sediment production.

2. Geologic units and their water-bearing characteristics and identification of geologic structure that may influence hydrology; and, in the L.C. Holding lease, general stability of local geologic units in relation to sediment production, road construction, and mining.

3. Ground-water recharge, movement, and discharge; ground-water quality; and ground water in storage.

4. Potential effects of coal mining on the premining hydrologic system of coal mining in and near the coal-lease areas.

   Completion of these objectives will allow BLM to evaluate several issues that have been identified in the past environmental impact statements as having insufficient analysis because of deficiencies in data. In addition, data collected in the L.C. Holding lease area in support of these objectives will allow better evaluation of the following local issues identified by the BLM District Office in Cedar City: (a) premining and potential postmining fluvial-sediment production in the lease area, (b) stability of geologic units during road construction and of overburden during underground coal mining (to evaluate the potential for land subsidence), (c) potential effects on the downstream surface-water habitat of the Virgin River spindace, (d) potential effects on the hydrology of alluvial valleys and floodplains if they or underlying aquifers are disrupted by mining, and (e) potential effects on the springs in Zion Canyon, Zion National Park.

C. Approach: The study will be conducted during the period October 1, 1985 to January 31, 1988 using the following techniques and collecting the following types of data:

1. Measure streamflow in and near the lease areas periodically and correlate flow with that for nearby gaging stations. Estimate average and peak flows using techniques and regression relations developed in the BLM/USGS Cooperative Hydrology Investigations Program. Sample streamflow for chemical analysis and periodically for suspended-sediment content.

2. Evaluate water-bearing characteristics of geologic units and hydrologic effects of geologic structure (supplementing available geologic maps with limited field investigations). Test holes drilled by BLM to evaluate coal resources will be utilized to obtain hydrologic data whenever possible. Tests will include determining the water level in each hole, taking a water sample, and attempting to determine hydraulic conductivity of the water-bearing material. In the L.C. Holding lease area, map extent of alluvial valley areas, if significant, and estimate extent of underlying alluvial aquifers. Locate any data on stability of geologic units, especially those that will be overburden during coal mining. Obtain consulting help from Geologic Division on stability of geologic units.

3. Identify sources of ground-water recharge, direction of movement, and points or areas of discharge. Make seepage runs on streams to identify areas of ground-water recharge and discharge if suitable stream reaches are available. Make a complete inventory of springs and wells in and near the lease areas. Use any available ground-water head data to estimate directions of movement. Obtain hydrologic data from nearby existing coal mines in hydrologically similar areas. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground water in storage, where possible.

4. In the L.C. Holding lease area, drill and test four holes. Testing will include running geophysical logs, measuring water levels, sampling for water quality, and estimating hydraulic conductivity from discharge/drawdown data, where possible. The resulting data will indicate aquifer characteristics and help in estimating potential effects of mining on the springs in Zion Canyon, west of the lease.

5. Make qualitative estimates of the potential hydrologic effects of mining using available hydrologic, mine-plan, mine-production, and mining-method data.

D. Progress: Literature search for data from and studies of the lease areas has been completed and field data collection is complete. Surface-water flow and quality have been measured in the L.C. Holding and Quitchupah-Pines lease areas and samples collected for chemical analysis. Springs and wells (L.C. Holding, only) in both lease areas have been inventoried and samples collected for chemical analysis. Data are being compiled, interpreted, and reports written for each area.

E. Reports: A report on each area will be prepared for submission to the WRD Regional Office (preliminary copy to BLM for comments) by January 31, 1988.

F. Distribution of Funds:

	FY 1988
Salaries and benefits	$20,500
Report process & print	4,000
Computer	500
TOTAL	$25,000

WASHINGTON

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Project	4134	6333	Total
I. Collect and analyze water samples from Midnight Mine	$15,000		$15,000
II. Sediment Sample Analysis		6,000	6,000
		$6,000	$21,000

Total for State of Washington: $21,000

WASHINGTON

Charles W. Luscher, BLM State Director (FTS 429-6251)
Bill Brookes, BLM Hydrologic Investigations Coordinator (FTS 429-2253)
Gerald D. Parker, WRD, District Chief (FTS 390-6510)

I. Analyze Water Samples - Midnight Mine

A. Location: Surface drainage and three pits of Midnight Mine, Stevens County, Washington.

B. Objectives: To collect and analyze water samples from surface drainage and three pits, install two staff gages in pit #3.

C. Report Products: Data will be stored in WATSTORE. Analytical results will be provided to BLM.

D. Distribution of Funds (OR-920-4134-06-2512):

Salaries and benefits	$15,000
TOTAL	$15,000

II. Sediment Sample Analysis

A. Location: Collect approximately 1,000 samples at various field sites, Salem District.

B. Product Output: Data will be entered into WATSTORE. Lab sheets (analytical results) will be provided to the Salem District, BLM.

C. Distribution of Funds (OR-080-6333-14-2512):

Salaries	$6,000
TOTAL	$6,000

WYOMING

SUMMARY OF FUNDS - FY 88
WATER RESOURCES DIVISION

Project	4121	Total
I. Ground-water recharge and discharge in coal backfill material	$65,000	$65,000
II. Test update of data base for ground-water site inventory system	20,000	20,000
TOTAL	$85,000	$85,000

Total for State of Wyoming: $85,000

WYOMING

Hillary A. Oden, BLM State Director (FTS 328-2326)
Cliff Franklin, BLM Hydrology Investigations Coordinator (FTS 328-2079)
James E. Kircher, WRD District Chief (FTS 328-2153)

I. Ground-Water Recharge and Discharge in Coal Backfill Material

Larry Martin, WRD Project Chief (FTS 328-2714)

A. Location: Powder River Basin, Wyoming

B. Objectives: To evaluate the magnitude and distribution of recharge and discharge in backfill aquifers of surface coal mines. This evaluation is needed to correctly predict the distribution of water-quality constituents within saturated backfill aquifers and to determine the correct placement strategy for toxic and acid-forming materials in the spoil aquifer. An evaluation of recharge and discharge under present conditions is also needed to correctly predict movement of water and dissolved chemicals from saturated backfill material to undisturbed aquifers or the land surface.

C. Procedures: The study is site specific. One coal mine in the Powder River Basin will be investigated. However, information and techniques developed at the selected coal mine will have transfer value throughout the Northern Great Plains. The significance of site-specific study to the regional ground-water flow system will be evaluated.

Precipitation gages will be used to determine the volume of water entering the ground-water and surface-water system at each site. The volume of water in the unsaturated zone will be measured using a neutron probe to show changes in soil-water content during the year, as well as changes in unsaturated zone storage from year to year. This information will help define the timing and depth of water movement through the reclaimed coal spoils and will indicate how rapidly water reaches the spoils aquifer. Monitor wells will be completed in the reclaimed spoils aquifer, underburden, and undisturbed areas. The wells must be completed in only one formation or aquifer. Water levels will be measured in the wells. Changes in water levels can be used to show changes in ground-water storage and also to define the potentiometric surface of aquifers. Isotope concentrations in ground water and precipitation will be used to determine and confirm sources of recharge and water movement in the spoil aquifer system. Aquifer tests will be conducted to define the transmissivity of the spoils aquifer. Steady-state modeling techniques may be used to simulate the ground-water system. Modeling would provide an estimate of the rate and distribution of mean annual recharge, and the interchange of flow among the underburden, undisturbed areas, and spoils.

Changes in model parameters can be tested to show effects of variation in precipitation recharge, hydraulic conductivity, and source of recharge water.

D. Report Products: Results of this study will be published as a Water Supply Paper or Water Resources Investigations Report and will be completed by September 1990.

E. Distribution of Funds: Funding from BLM will be distributed as follows:

Salaries	$30,000
Travel	2,000
Construction	3,000
Water Samples	20,000
Equipment and Supplies	10,000
TOTAL	$65,000

II. Test Update of the Data Base for the Ground-Water Site Inventory System

J.L. Lunsford, WRD Project Chief (FTS 328-2714)

A. Location: Northeastern Wyoming

B. Objectives: USGS maintains a computerized data base, the Ground-Water Site Inventory (GWSI), as part of its National Water Information System (NWIS). The objective of this study is to examine the GWSI data base for a specific area in the Casper District of the BLM, to identify information on wells in the area that should be modified or deleted from GWSI, to input into GWSI new information for wells in the area, and to make a refined data base available to BLM staff in the Casper District and the Wyoming State Office.

C. Procedures: The initial effort of the study will be limited to an area along the outcrop of the Wyodak coal bed in eastern Campbell County and northeastern Converse County. This area was chosen for the initial effort because it contains a significant proportion of the total number of wells in the Casper District, and because the USGS presently has a file of the Wyoming State Engineer's records for the wells in this area.

The first step in cleaning up the data base will be protecting all the sites in GWSI that have water-quality data. GWSI information on wells sampled for water quality generally is considered to be accurate because at least one field visit has been made to the site. These sites will not be modified.

The second step in the clean up process will be comparing information from GWSI on the number and location of wells in quadrangle with comparable information from the Wyoming State Engineer (WSE). Information in the GWSI or a separate computer file will be updated and corrected as necessary using information on well completions from the State Engineer's Office.

Statistical testing of certain data fields for all sites in a quadrangle will be used to identify and correct gross data-entry errors.

D. Report Products: At the end of the effort, USGS personnel will meet with BLM Casper District and Wyoming State Office personnel to brief them and provide documentation on the procedure and computer programs used for selecting and testing the ground-water data by September 1988.

E. Distribution of Funds:

Salary	$17,500
Computer	2,000
Supplies	500
TOTAL	$20,000

ER'S CARD

1988

	OFFICE	DATE RETURNED

(Continued on reverse)

BLM LIBRARY
SC-324A, BLDG. 50
DENVER FEDERAL CENTER
P. O. BOX 25047
DENVER, CO 80225-0047

Summary

Plan of Work

Colorado

Idaho

Montana

Oregon

Utah

Washington

Wyoming